Assembly Instructions MP-M Memory Board

Introduction

The MP-M Memory Board is a 5 1/2" x 9" double sided plated thru hole board with a total storage capability of 4,096 words of 8 bit random asscess memory. The kit, however, is supplied with only half (2,048 words) of it's memory capacity. To bring the board to maximum capacity, you must purchase the MP-MX memory memory expansion kit. The circuitry on the board provides all of the address decoding and data line buffering to handle a total of 32 (1K bit x 1 bit) 2102 type static random access memories. All interconnections to the system are made via a 50 pin connector to the Mother Board (MP-B). +5 volt power for the board is supplied by a on board regulator with heatsink for each 2,048 words of memory. Current consumption is approximately 0.75 A for every 2,048 words of memory.

Although this board is supplied with the MP-6800 Package, it is not necessary to have this board installed for system checkout. In fact this board should not even be installed when the system is first operated. All Random Access Memory (RAM) required by the mini-operating system is in the 6810 RAM memory chip on the MP-A Microprocessor/System Board. For this reason you may wish to delay assembling this board until you have the rest of the system up and running.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil

of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the Introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.

( ) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.

( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Solder.

( ) Starting from one end of the circuit board install each of the five, 10 pin Molex female edge connectors along the lower edge of the board. These connectors must be inserted from the "TOP" side of the board and must be pressed down firmly against the board. Make sure the body of the connector seats firmly against the circuit board and that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugged onto the mother board. It is suggested that you solder only the two end pins of each of the five connectors until all have been installed at which time if everything looks straight and rigid you should solder the as yet unsoldered pins.

( ) Insert the small nylon indexing plug into the edge connector pin indicated by the small triangular arrow on the "BOTTOM" side of the circuit board. This prevents the board from being accidentally plugged onto the mother board incorrectly.

( ) Install integrated circuits IC18 thru IC24. As each one is installed make sure it is down firmly against the board and solder only two of the leads to hold the pack in place while the other IC's are being inserted.

Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semicircle notch or dot on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's. After inserting all of the integrated circuits go back and solder each of the as yet unsoldered pins.

( ) Install integrated circuit IC17 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place; the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC1 thru IC16 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Integrated circuits IC25-IC41 and capacitors C6-C9 are not used in this kit - they are added later if you purchase the MP-MX memory expansion kit.

( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really

cause some hard to find problems later during check out. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly of the MP-M board. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing ANYTHING to come into contact with any of the conductors on the board.

MP-M Memory Board Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are not solder or foil conductor "bridges" or "breaks".

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC17 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board has only 2,048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board had the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The actual bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The ten address lines A_0 thru A_9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight integrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2.048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-M Memory Board

Resistors

R1	1K ohm 1/4 watt resistor

Capacitors

C1	100 mfd @16 volt electrolytic capacitor
C2 - C5	0.1 mfd disc capacitor

Semiconductors

IC-1 - IC-16		2102-1 or 2 Static random access memory (MOS)
IC17		7805 5V 1A regulator
IC-18, IC-19	— SN74367 —	DM8097 TRI-STATE® hex buffer
IC-20, IC-21		DM8835 Quad TRI-STATE® transceiver
IC-22, IC-23		74S138 3 to 8 line decoder
IC-24		7402 Quad 2 input NOR gate

Memory Address Assignment Table (Hex)

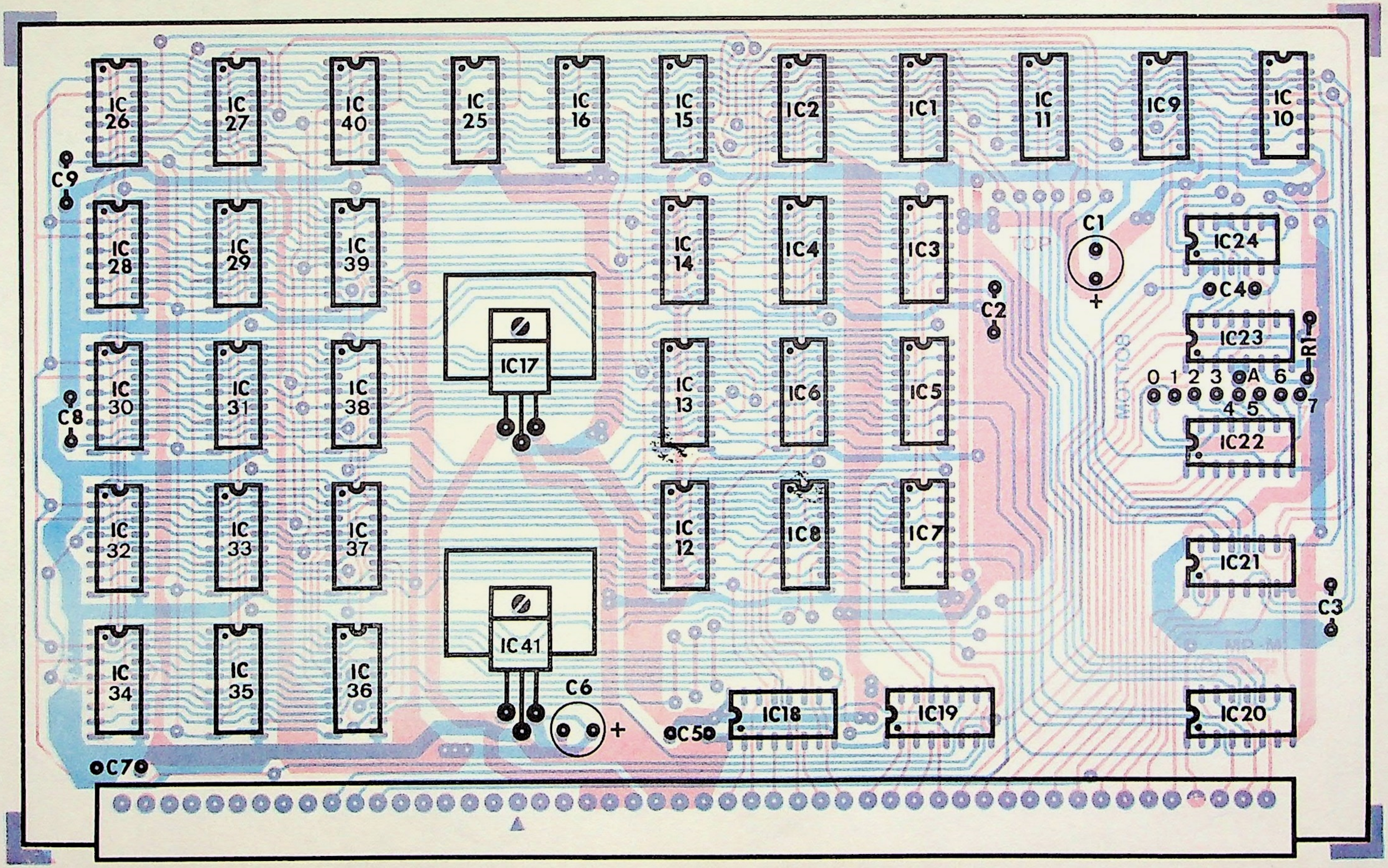
Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

08 hex = 0000 1000 binary
10 hex = 0001 0000 binary
20 hex = 0010 0000 binary
40 hex = 0100 0000 binary
80 hex = 1000 0000 binary


IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
C1
+
IC24
C2
C4
IC17
IC23
R1
IC 30
IC 31
IC 38
IC 13
IC6
IC5
0 1 2 3 A 6
4 5
7
C8
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
IC21
C3
IC41
IC 34
IC 35
IC 36
C6
+
C5
IC18
IC19
IC20
C7

Assembly Instructions MP-MX Memory Expansion Kit

Introduction

The MP-MX Memory Expansion kit contains all the parts necessary to expand a SWTPC MP-M memory board to its full 4,096 word capability. The circuitry to provide all of the address decoding and data line buffering to handle all 32 2102 random access memories was already installed when building the standard 2,048 word MP-M kit. The MP-MX expansion kit should not be installed until it has been verified that the first 2,048 words of memory on the standard MP-M board is fully operational.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on

the board.

( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitor correctly. Use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. The polarity is indicated on the component layout drawing. Solder.

( ) Install integrated circuit IC41 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (seperately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC25 thru IC40 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board and solder only two of the leads to hole the pack in place while the other IC's are being installed. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Solder the remaining IC pins.

( ) Working from the "TOP" side of the board fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes that make electrical connection from the "TOP" of the board to the "BOTTOM" of the board. Do not fill in the holes marked A and 0 - 7.

( ) Check very carefully to make sure that all connections have been soldered.

It is very easy to miss some connections when soldering which can really cause some hard to find problems later during check out. Also look for solder "bridges" or "cold" solder joints which are another common problem.

This completes the installation for the MP-MX Memory Expansion Kit. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are no solder or foil conductor "bridges" or "breaks"

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC41 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board had only 2.048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board has the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The acutal bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The then address lines A_0 thru A_9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight intergrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2,048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-MX Memory Expansion Kit

Capacitors

C6	100 mfd @16 volt electrolytic capacitor
C7 - C9	0.1 mfd disc capacitor

Semiconductors

IC-25 - IC40	2102-1 or 2 Static random access memory (MOS)
IC41	7805 5V 1A regulator

Memory Address Assignment Table (Hex)

Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

08 hex = 0000 1000 binary
10 hex = 0001 0000 binary
20 hex = 0010 0000 binary
40 hex = 0100 0000 binary
80 hex = 1000 0000 binary

Assembly Instructions MP-M Memory Board

Introduction

The MP-M Memory Board is a 5 1/2" x 9" double sided plated thru hole board **with a total storage** capability of 4,096 words of 8 bit random asscess memory. The kit, however, is supplied with only half (2,048 words) of it's memory capacity. To bring the board to maximum capacity, you must purchase the MP-MX memory memory expansion kit. The circuitry on the board provides all of the address decoding and data line buffering to handle a total of 32 (1K bit x 1 bit) 2102 type static random access memories. All interconnections to the system are made via a 50 pin connector to the Mother Board (MP-B). +5 volt power for the board is supplied by a on board regulator with heatsink for each 2,048 words of memory. Current consumption is approximately 0.75 A for every 2,048 words of memory.

Although this board is supplied with the MP-6800 Package, it is not necessary to have this board installed for system checkout. In fact this board should not even be installed when the system is first operated. All Random Access Memory (RAM) required by the mini-operating system is in the 6810 RAM memory chip on the MP-A Microprocessor/System Board. For this reason you may wish to delay assembling this board until you have the rest of the system up and running.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil

of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the Introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

(✓) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.

(✓) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.

(✓) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Solder.

(✓) Starting from one end of the circuit board install each of the five, 10 pin Molex female edge connectors along the lower edge of the board. These connectors must be inserted from the "TOP" side of the board and must be pressed down firmly against the board. Make sure the body of the connector seats firmly against the circuit board and that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugged onto the mother board. It is suggested that you solder only the two end pins of each of the five connectors until all have been installed at which time if everything looks straight and rigid you should solder the as yet unsoldered pins.

(✓) Insert the small nylon indexing plug into the edge connector pin indicated by the small triangular arrow on the "BOTTOM" side of the circuit board. This prevents the board from being accidentally plugged onto the mother board incorrectly.

(✓) Install integrated circuits IC18 thru IC24. As each one is installed make sure it is down firmly against the board and solder only two of the leads to hold the pack in place while the other IC's are being inserted.

Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semicircle notch or dot on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's. After inserting all of the integrated circuits go back and solder each of the as yet unsoldered pins.

(✓) Install integrated circuit IC17 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place; the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

(✓) Install MOS integrated circuits IC1 thru IC16 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

(✓) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Integrated circuits IC25-IC41 and capacitors C6-C9 are not used in this kit - they are added later if you purchase the MP-MX memory expansion kit.

(✓) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really

cause some hard to find problems later during check out. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly of the MP-M board. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing ANYTHING to come into contact with any of the conductors on the board.

MP-M Memory Board Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are not solder or foil conductor "bridges" or "breaks".

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC17 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board has only 2,048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board had the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

~~end of this instruction~~ set to determine the proper starting and ending

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The actual bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The ten address lines Ao thru A9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight integrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2.048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-M Memory Board

Resistors

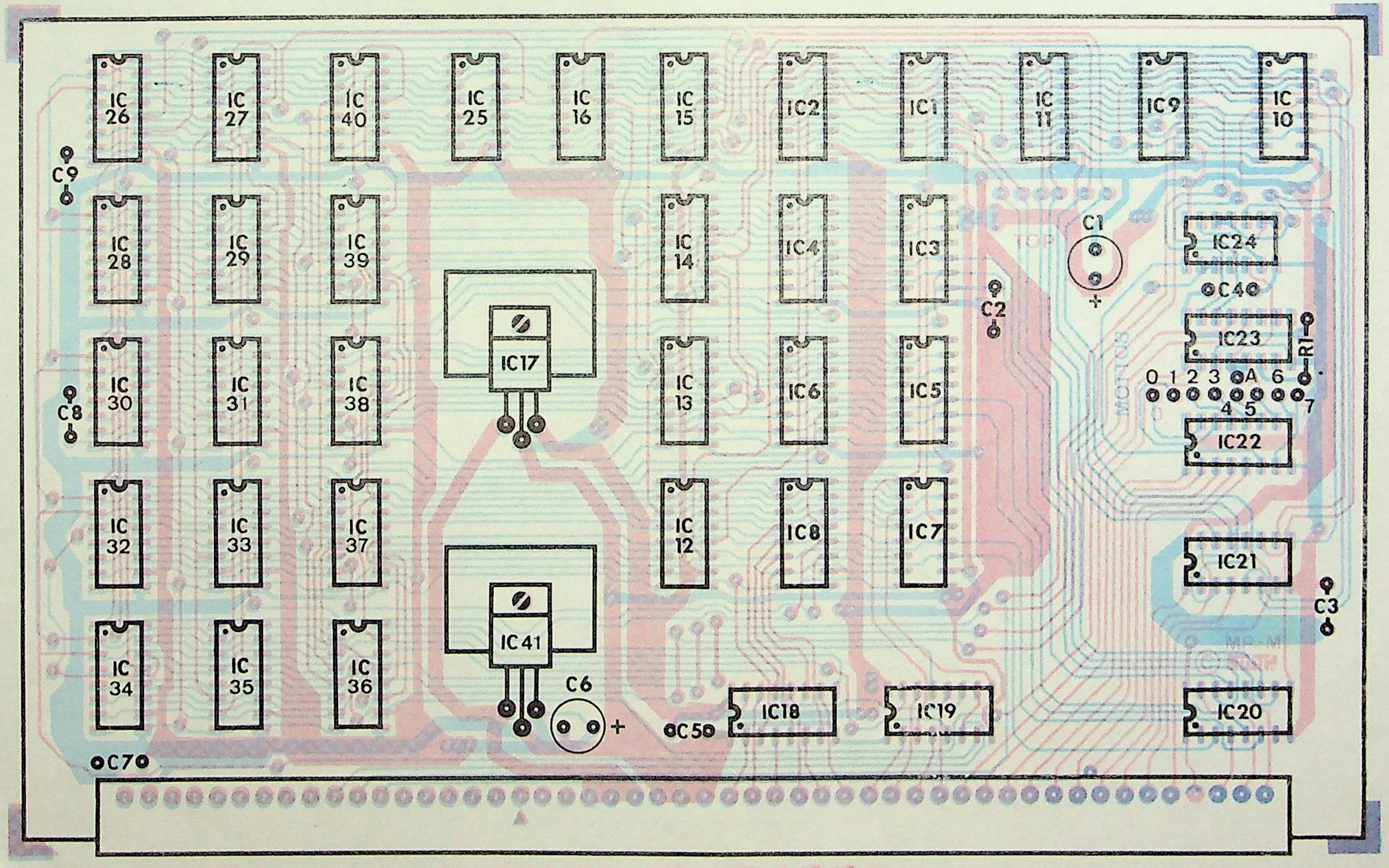
R1	1K ohm 1/4 watt resistor

Capacitors

C1	100 mfd @16 volt electrolytic capacitor
C2 - C5	0.1 mfd disc capacitor

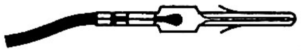
Semiconductors

IC-1 - IC-16	2102-1 or 2 Static random access memory (MOS)
IC17	7805 5V 1A regulator
IC-18, IC-19	DM8097 TRI-STATE® hex buffer
IC-20, IC-21	DM8835 Quad TRI-STATE® transceiver
IC-22, IC-23	74S138 3 to 8 line decoder
IC-24	7402 Quad 2 input NOR gate

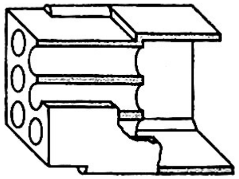

IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
C1
TOP
IC24
C4
C2
+
IC17
IC23
R1
MOTOR
0 1 2 3 A 6
4 5 7
C8
IC 30
IC 31
IC 38
IC 13
IC6
IC5
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
IC21
IC41
C3
IC 34
IC 35
IC 36
C6
+
C5
IC18
IC19
IC20
C7

Connector Reference Sheet

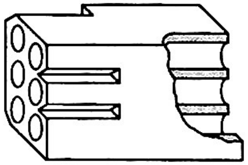
In order to avoid confusion in distinguishing between the various connectors supplied with our many kits, we are including this connector reference sheet with the kit instruction set. We have had a great many customers interchange the male and female connector shells when assembling their kits so we have clearly illustrated each connector along with its proper name and gender on this reference sheet. All are shown actual size.



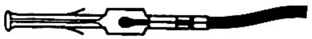
Male Pin



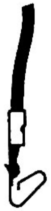
Molex Female Shell Connector



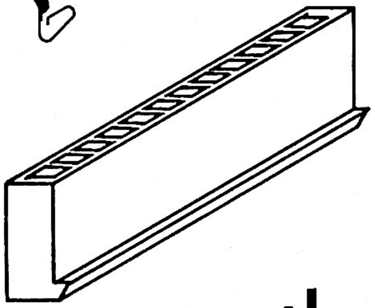
Molex Male Shell Connector



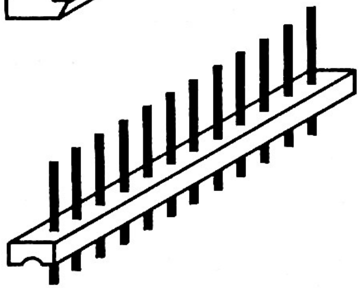
Female Pin



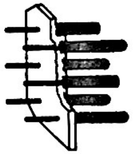
Pin for Harness Connector



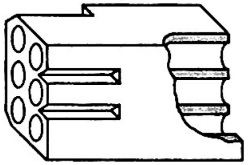
Harness Connector



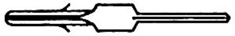
Straight Pin Edge Connector



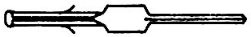
Molex Wafercon®



Molex Male Shell Connector



Male Solder Tail Pin
PC Type



Female Solder Tail Pin
PC Type

Memory Address Assignment Table (Hex)

Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

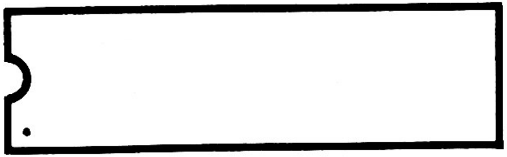
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

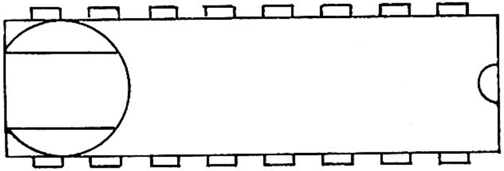
08 hex = 0000 1000 binary
10 hex = 0001 0000 binary
20 hex = 0010 0000 binary
40 hex = 0100 0000 binary
80 hex = 1000 0000 binary

Important Note—Integrated Circuit Installation

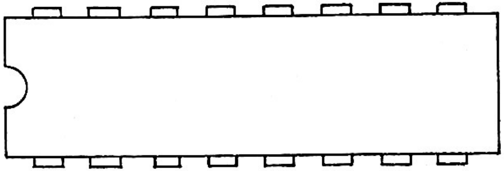
As you follow the assembly instructions, you will come to the step where you are told to install the integrated circuits. The instructions state that you must orient the integrated circuits to be installed so that the notch on the top of the integrated circuit package matches with that shown in the component layout drawing. Some of the integrated circuits supplied with your kit may have more than one notch on the top of the package. If so, the elongated notch is the one to be used for orientation purposes. (See drawing at right). If you accidently install an integrated circuit backwards, not only will it be hard to correct; but it may be damaged if power is applied while it is incorrectly installed. So be careful!



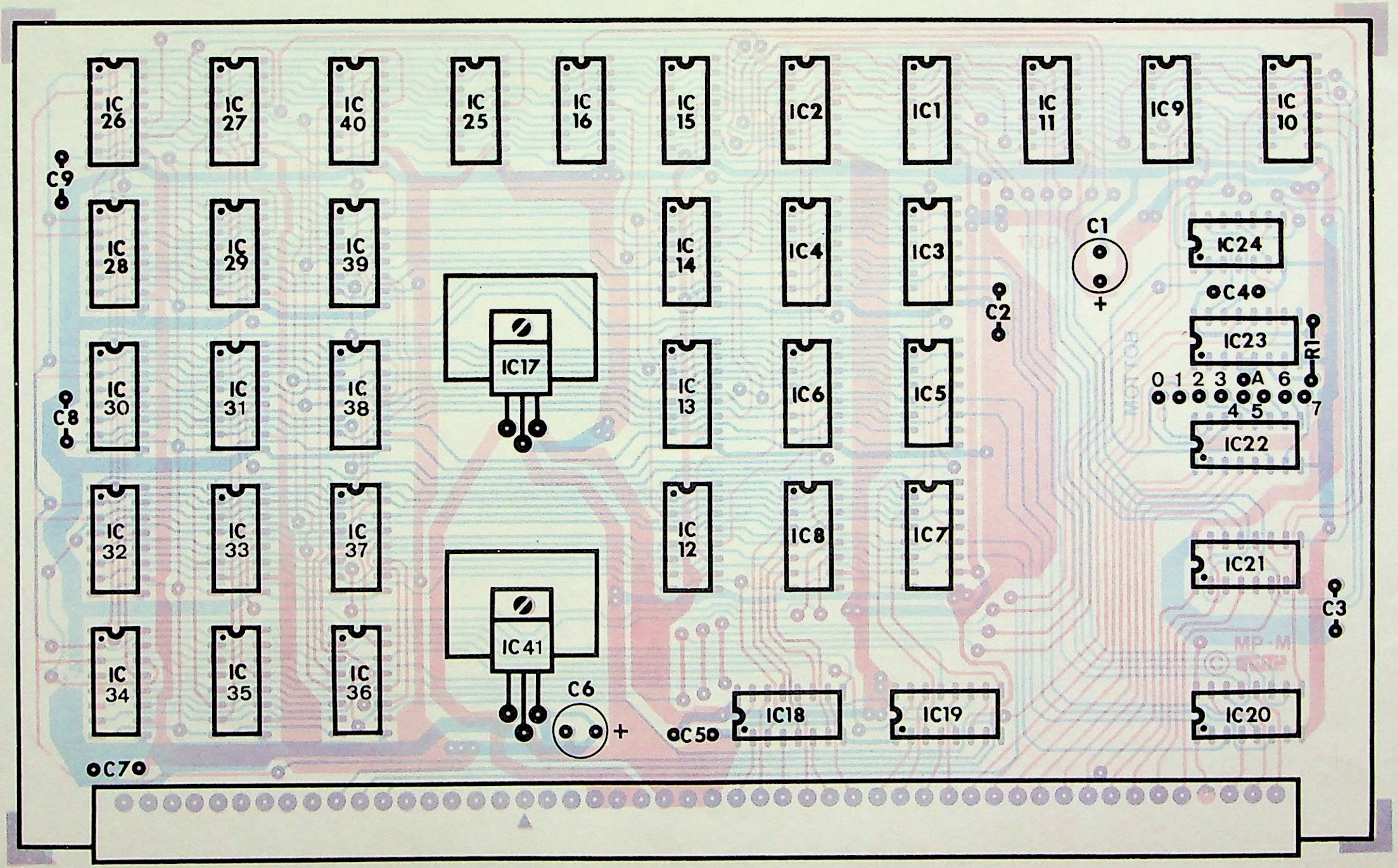
Component Layout Outline



Actual Component from Top



Actual Component from Top


IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
C1
IC24
C4
C2
IC17
IC23
R1
0 1 2 3 A 6
4 5 7
C8
IC 30
IC 31
IC 38
IC 13
IC6
IC5
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
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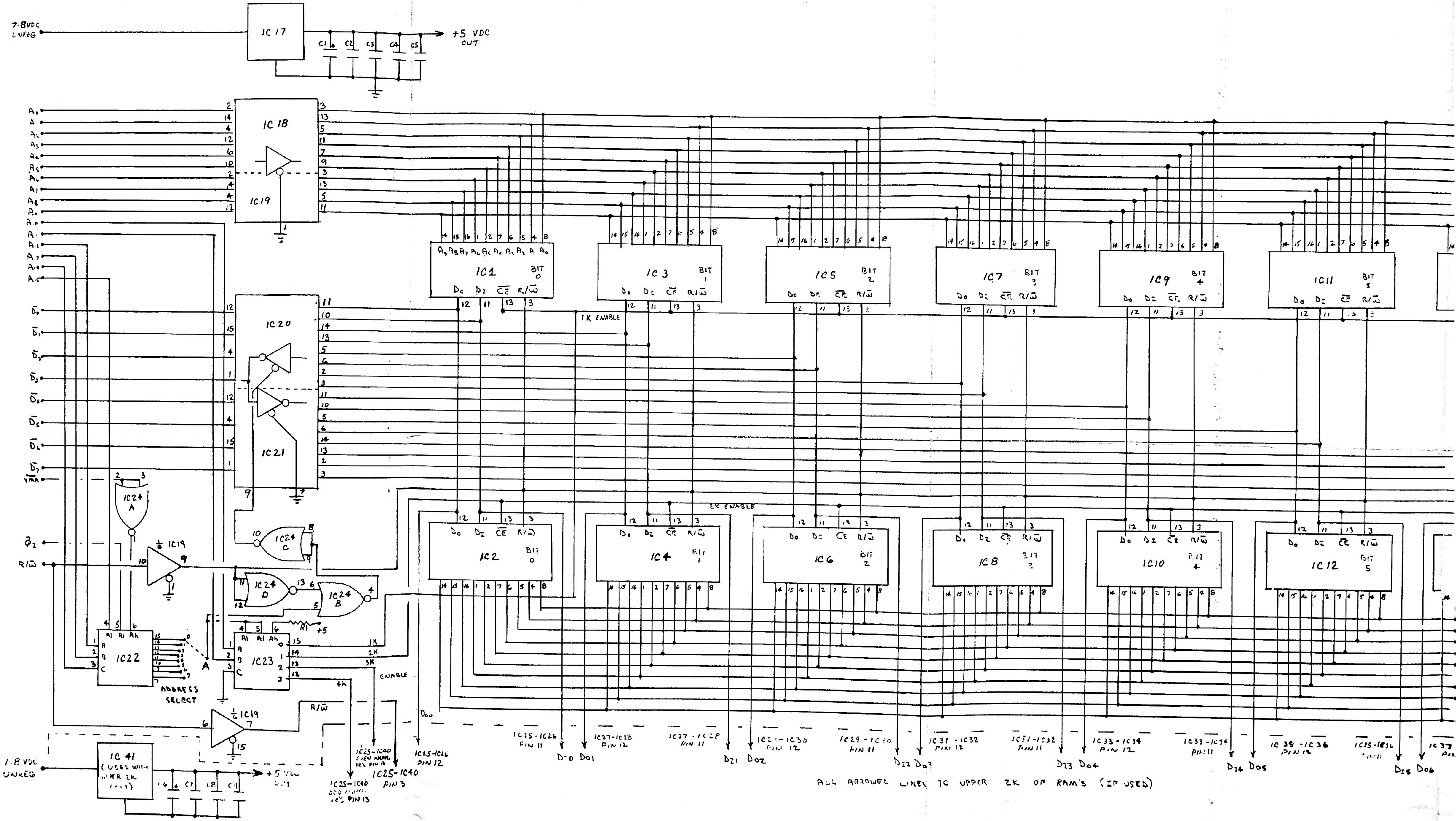
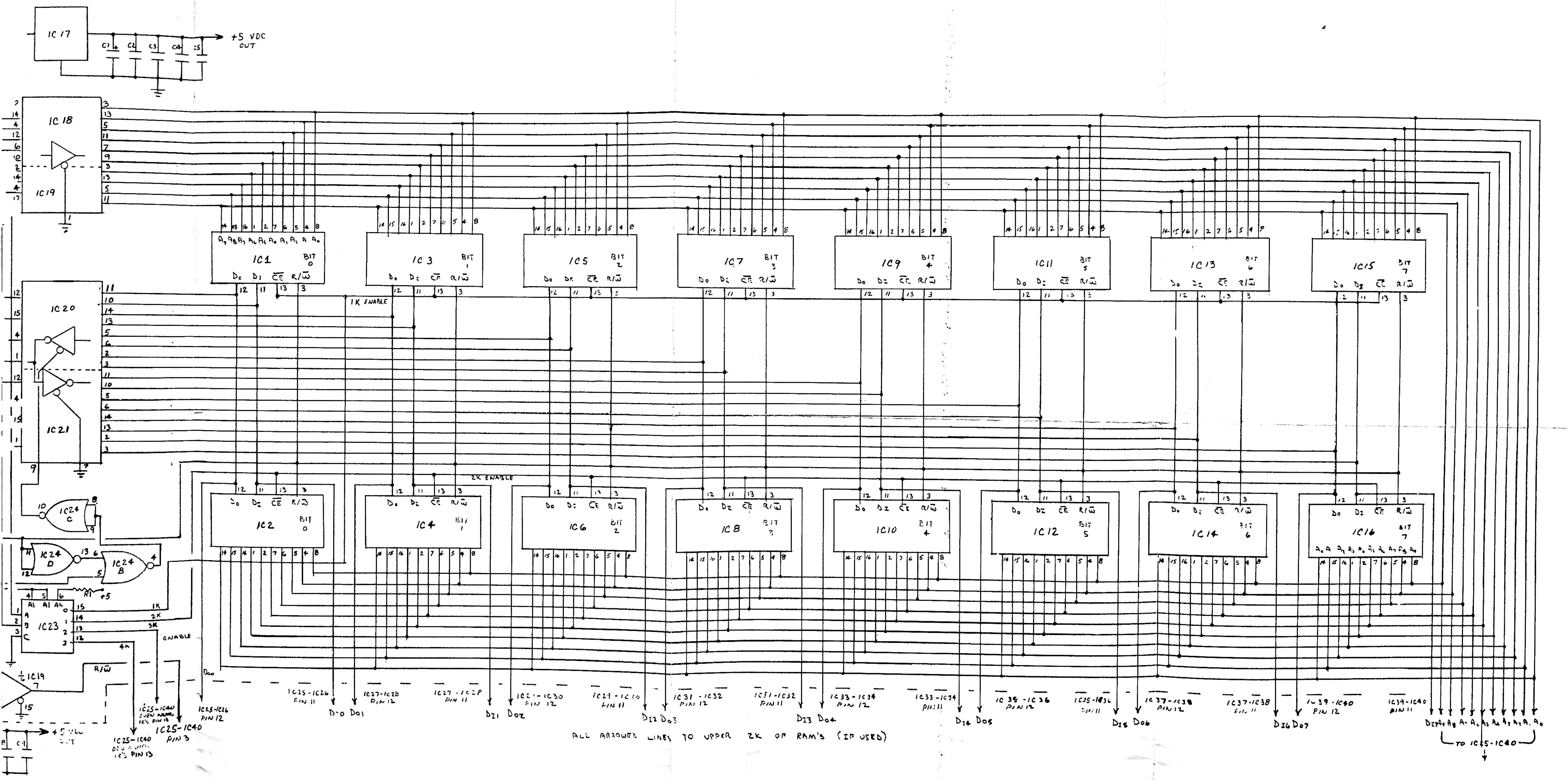
C3
IC41
MP-M
IC 34
IC 35
IC 36
C6
C5
IC18
IC19
IC20
C7


7-8VDC UNREG
IC 17
C1 C2 C3 C4 C5
+5 VDC OUT
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15
IC 18
IC 19
IC 20
IC 21
D̄0 D̄1 D̄2 D̄3 D̄4 D̄5 D̄6 D̄7
VMA
IC24 A
Φ2
R/W̄
1/6 IC19
IC24 C
IC24 D
IC24 B
R1 +5
IC22
ADDRESS SELECT
A
IC23
1K 2K 3K 4K
ENABLE
1K ENABLE
2K ENABLE
IC1 BIT 0
IC3 BIT 1
IC5 BIT 2
IC7 BIT 3
IC9 BIT 4
IC11 BIT 5
IC2 BIT 0
IC4 BIT 1
IC6 BIT 2
IC8 BIT 3
IC10 BIT 4
IC12 BIT 5
D0 D1 CE R/W̄
1/6 IC19
IC 41 (USED WITH UPPER 2K ONLY)
7-8 VDC UNREG
C6 C7 C8 C9
+5 VDC OUT
R/W̄
D00
IC25-IC40 EVEN NUMB. IC's PIN 13
IC25-IC40 ODD NUMB. IC's PIN 13
IC25-IC40 PIN 3
IC25-IC26 PIN 12
IC25-IC26 PIN 11
IC27-IC28 PIN 12
IC27-IC28 PIN 11
IC29-IC30 PIN 12
IC29-IC30 PIN 11
IC31-IC32 PIN 12
IC31-IC32 PIN 11
IC33-IC34 PIN 12
IC33-IC34 PIN 11
IC35-IC36 PIN 12
IC35-IC36 PIN 11
IC37
DI0 DO1
DI1 DO2
DI2 DO3
DI3 DO4
DI4 DO5
DI5 DO6
ALL ARROWED LINES TO UPPER 2K OF RAM'S (IF USED)

Schematic - MP-M/MP-MX Memory Board


IC17
C1
C2
C3
C4
C5
+5 VDC OUT
IC18
IC19
IC20
IC21
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
BIT 0
BIT 1
BIT 2
BIT 3
BIT 4
BIT 5
BIT 6
BIT 7
D0
DI
CE
R/W
1K ENABLE
2K ENABLE
IC24 C
IC24 D
IC24 B
R1
+5
IC23
1K
2K
3K
4K
ENABLE
R/W
1/6 IC19
D00
IC25-IC26 PIN 11
IC27-IC28 PIN 12
IC27-IC28 PIN 11
IC29-IC30 PIN 12
IC29-IC30 PIN 11
IC31-IC32 PIN 12
IC31-IC32 PIN 11
IC33-IC34 PIN 12
IC33-IC34 PIN 11
IC35-IC36 PIN 12
IC35-IC36 PIN 11
IC37-IC38 PIN 12
IC37-IC38 PIN 11
IC39-IC40 PIN 12
IC39-IC40 PIN 11
IC25-IC26 PIN 12
IC25-IC40 EVEN NUMB. IC'S PIN 13
IC25-IC40 PIN 3
IC25-IC40 ODD NUMB. IC'S PIN 13
DI0 D01
DI1 D02
DI2 D03
DI3 D04
DI4 D05
DI5 D06
DI6 D07
DI7 A9 A8 A7 A6 A5 A4 A3 A2 A1 A0
TO IC25-IC40
ALL ARROWED LINES TO UPPER 2K OF RAM'S (IF USED)
+5 VDC OUT

Schematic - MP-M/MP-MX Memory Board

Assembly Instructions MP-MX Memory Expansion Kit

Introduction

The MP-MX Memory Expansion kit contains all the parts necessary to expand a SWTPC MP-M memory board to its full 4,096 word capability. The circuitry to provide all of the address decoding and data line buffering to handle all 32 2102 random access memories was already installed when building the standard 2,048 word MP-M kit. The MP-MX expansion kit should not be installed until it has been verified that the first 2,048 words of memory on the standard MP-M board is fully operational.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on

the board.

( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitor correctly. Use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. The polarity is indicated on the component layout drawing. Solder.

( ) Install integrated circuit IC41 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (seperately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC25 thru IC40 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board and solder only two of the leads to hole the pack in place while the other IC's are being installed. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Solder the remaining IC pins.

( ) Working from the "TOP" side of the board fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes that make electrical connection from the "TOP" of the board to the "BOTTOM" of the board. Do not fill in the holes marked A and 0 - 7.

( ) Check very carefully to make sure that all connections have been soldered.

It is very easy to miss some connections when soldering which can really cause some hard to find problems later during check out. Also look for solder "bridges" or "cold" solder joints which are another common problem.

This completes the installation for the MP-MX Memory Expansion Kit. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are no solder or foil conductor "bridges" or "breaks"

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC41 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board had only 2.048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board has the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The acutal bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The then address lines A_0 thru A_9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight intergrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2,048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-MX Memory Expansion Kit

Capacitors

C6	100 mfd @16 volt electrolytic capacitor
C7 - C9	0.1 mfd disc capacitor

Semiconductors

IC-25 - IC40	2102-1 or 2 Static random access memory (MOS)
IC41	7805 5V 1A regulator

Memory Address Assignment Table (Hex)

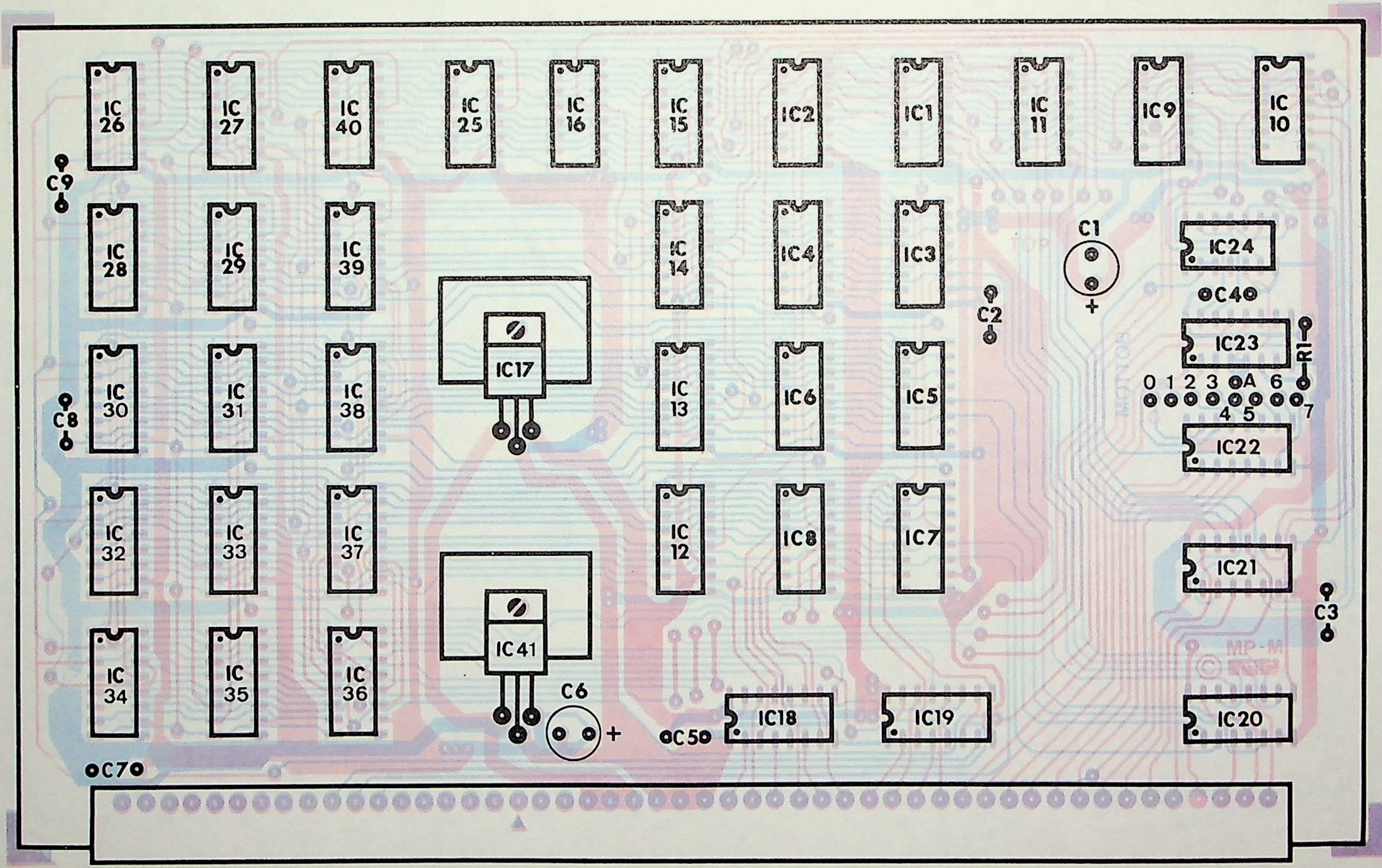
Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

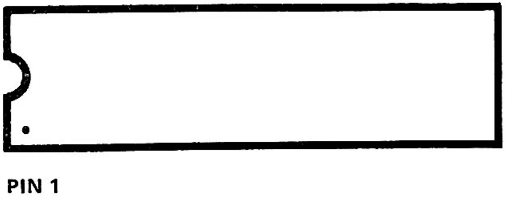
00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

08 hex = 0000 1000 binary
10 hex = 0001 0000 binary
20 hex = 0010 0000 binary
40 hex = 0100 0000 binary
80 hex = 1000 0000 binary

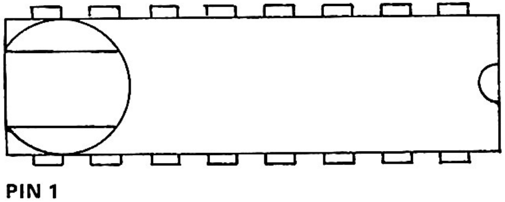

IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
C1
IC24
C2
C4
IC17
IC23
R1
C8
IC 30
IC 31
IC 38
IC 13
IC6
IC5
0 1 2 3 A 6
4 5 7
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
IC21
C3
IC 34
IC 35
IC 36
IC41
C6
C5
IC18
IC19
IC20
C7
MP-M
+

Important Note—Integrated Circuit Installation

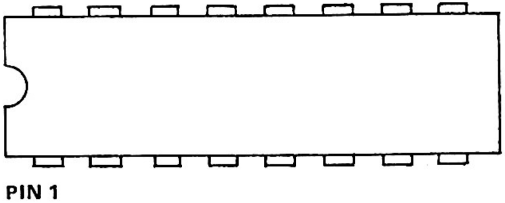
As you follow the assembly instructions, you will come to the step where you are told to install the integrated circuits. The instructions state that you must orient the integrated circuits to be installed so that the notch on the top of the integrated circuit package matches with that shown in the component layout drawing. Some of the integrated circuits supplied with your kit may have more than one notch on the top of the package. If so, the elongated notch is the one to be used for orientation purposes. (See drawing at right). If you accidently install an integrated circuit backwards, not only will it be hard to correct; but it may be damaged if power is applied while it is incorrectly installed. So be careful!



Component Layout Outline



Actual Component from Top



Actual Component from Top

Assembly Instructions MP-MX Memory Expansion Kit

Introduction

The MP-MX Memory Expansion kit contains all the parts necessary to expand a SWTPC MP-M memory board to its full 4,096 word capability. The circuitry to provide all of the address decoding and data line buffering to handle all 32 2102 random access memories was already installed when building the standard 2,048 word MP-M kit. The MP-MX expansion kit should not be installed until it has been verified that the first 2,048 words of memory on the standard MP-M board is fully operational.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on

the board.

(✓) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitor correctly. Use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. The polarity is indicated on the component layout drawing. Solder.

(✓) Install integrated circuit IC41 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (seperately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC25 thru IC40 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board and solder only two of the leads to hole the pack in place while the other IC's are being installed. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Solder the remaining IC pins.

( ) Working from the "TOP" side of the board fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes that make electrical connection from the "TOP" of the board to the "BOTTOM" of the board. Do not fill in the holes marked A and 0 - 7.

( ) Check very carefully to make sure that all connections have been soldered.

It is very easy to miss some connections when soldering which can really cause some hard to find problems later during check out. Also look for solder "bridges" or "cold" solder joints which are another common problem.

This completes the installation for the MP-MX Memory Expansion Kit. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are no solder or foil conductor "bridges" or "breaks".

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC41 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board had only 2.048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board has the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The acutal bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The then address lines A_0 thru A_9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight intergrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2,048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-MX Memory Expansion Kit

Capacitors

C6	100 mfd @16 volt electrolytic capacitor
C7 - C9	0.1 mfd disc capacitor

Semiconductors

IC-25 - IC40	2102-1 or 2 Static random access memory (MOS)
IC41	7805 5V 1A regulator

Memory Address Assignment Table (Hex)

Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
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	4	1C00	1FFF
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	3	2800	2BFF
	4	2C00	2FFF
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	3	3800	3BFF
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	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
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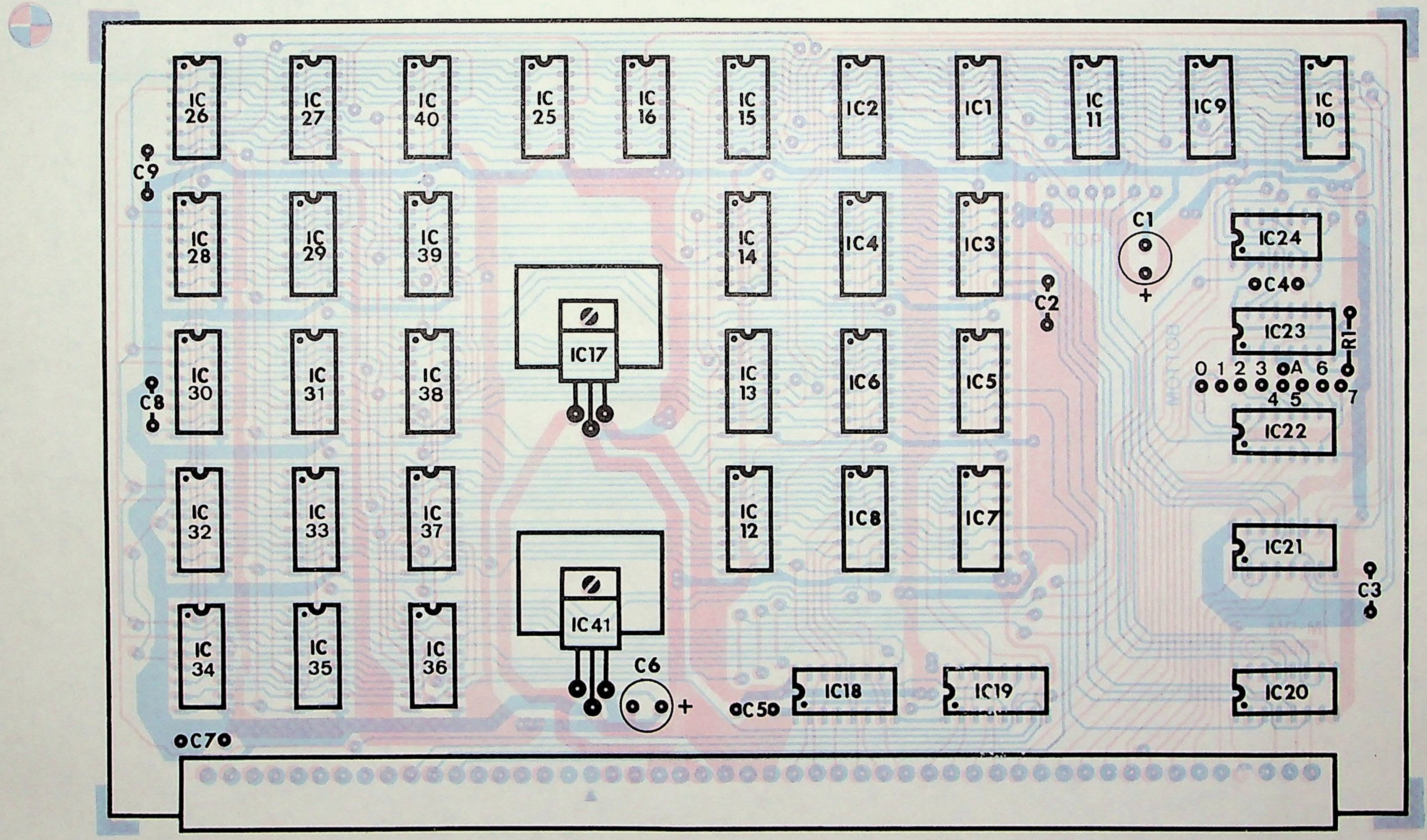
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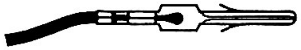
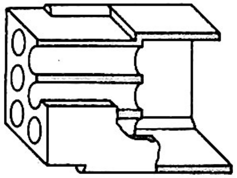
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
C1
+
IC24
C4
C2
IC17
IC23
R1
0 1 2 3 A 6
4 5 7
C8
IC 30
IC 31
IC 38
IC 13
IC6
IC5
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
IC21
C3
IC 34
IC 35
IC 36
IC41
C6
+
C5
IC18
IC19
IC20
C7

Connector Reference Sheet

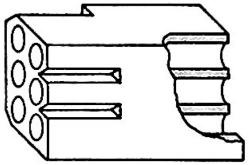
In order to avoid confusion in distinguishing between the various connectors supplied with our many kits, we are including this connector reference sheet with the kit instruction set. We have had a great many customers interchange the male and female connector shells when assembling their kits so we have clearly illustrated each connector along with its proper name and gender on this reference sheet. All are shown actual size.



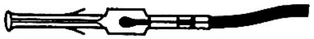
Male Pin



Molex Female Shell Connector



Molex Male Shell Connector



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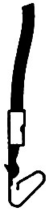
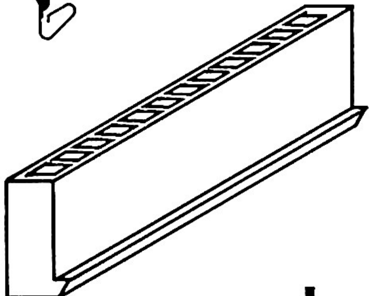
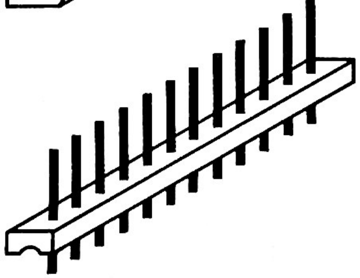


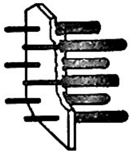
Pin for Harness Connector



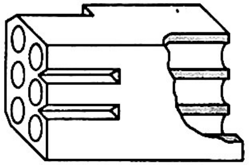
Harness Connector



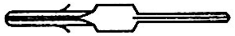
Straight Pin Edge Connector



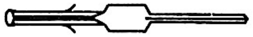
Molex Wafercon®



Molex Male Shell Connector



Male Solder Tail Pin PC Type



Female Solder Tail Pin PC Type

Assembly Instructions MP-M Memory Board

Introduction

The MP-M Memory Board is a 5 1/2" x 9" double sided plated thru hole board with a total storage capability of 4,096 words of 8 bit random asscess memory. The kit, however, is supplied with only half (2,048 words) of it's memory capacity. To bring the board to maximum capacity, you must purchase the MP-MX memory memory expansion kit. The circuitry on the board provides all of the address decoding and data line buffering to handle a total of 32 (1K bit x 1 bit) 2102 type static random access memories. All interconnections to the system are made via a 50 pin connector to the Mother Board (MP-B). +5 volt power for the board is supplied by a on board regulator with heatsink for each 2,048 words of memory. Current consumption is approximately 0.75 A for every 2,048 words of memory.

Although this board is supplied with the MP-6800 Package, it is not necessary to have this board installed for system checkout. In fact this board should not even be installed when the system is first operated. All Random Access Memory (RAM) required by the mini-operating system is in the 6810 RAM memory chip on the MP-A Microprocessor/System Board. For this reason you may wish to delay assembling this board until you have the rest of the system up and running.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil

of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the Introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

(✓) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.

(✓) Attach all of the resistors to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.

(✓) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitors correctly. The polarity is indicated on the component layout drawing. Solder.

(✓) Starting from one end of the circuit board install each of the five, 10 pin Molex female edge connectors along the lower edge of the board. These connectors must be inserted from the "TOP" side of the board and must be pressed down firmly against the board. Make sure the body of the connector seats firmly against the circuit board and that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugged onto the mother board. It is suggested that you solder only the two end pins of each of the five connectors until all have been installed at which time if everything looks straight and rigid you should solder the as yet unsoldered pins.

(✓) Insert the small nylon indexing plug into the edge connector pin indicated by the small triangular arrow on the "BOTTOM" side of the circuit board. This prevents the board from being accidentally plugged onto the mother board incorrectly.

(✓) Install integrated circuits IC18 thru IC24. As each one is installed make sure it is down firmly against the board and solder only two of the leads to hold the pack in place while the other IC's are being inserted.

Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semicircle notch or dot on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's. After inserting all of the integrated circuits go back and solder each of the as yet unsoldered pins.

(✓) Install integrated circuit IC17 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place; the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC1 thru IC16 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board before soldering all of its leads. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Integrated circuits IC25-IC41 and capacitors C6-C9 are not used in this kit - they are added later if you purchase the MP-MX memory expansion kit.

( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really

cause some hard to find problems later during check out. Also look for solder "bridges" and "cold" solder joints which are another common problem.

This completes the assembly of the MP-M board. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing ANYTHING to come into contact with any of the conductors on the board.

MP-M Memory Board Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are not solder or foil conductor "bridges" or "breaks".

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC17 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board has only 2,048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board had the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The actual bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The ten address lines Ao thru A9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight integrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2.048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-M Memory Board

Resistors

R1	1K ohm 1/4 watt resistor

Capacitors

C1	100 mfd @16 volt electrolytic capacitor
C2 - C5	0.1 mfd disc capacitor

Semiconductors

IC-1 - IC-16	2102-1 or 2 Static random access memory (MOS)
IC17	7805 5V 1A regulator
IC-18, IC-19	DM8097 TRI-STATE® hex buffer
IC-20, IC-21	DM8835 Quad TRI-STATE® transceiver
IC-22, IC-23	74S138 3 to 8 line decoder
IC-24	7402 Quad 2 input NOR gate

Assembly Instructions MP-MX Memory Expansion Kit

Introduction

The MP-MX Memory Expansion kit contains all the parts necessary to expand a SWTPC MP-M memory board to its full 4,096 word capability. The circuitry to provide all of the address decoding and data line buffering to handle all 32 2102 random access memories was already installed when building the standard 2,048 word MP-M kit. The MP-MX expansion kit should not be installed until it has been verified that the first 2,048 words of memory on the standard MP-M board is fully operational.

When you do assemble the board you will find that because of the small conductors and pads used, you will need a 15 - 25 watt soldering iron for small solder connections in addition to a 30 - 50 watt iron which must be used on larger solder connections.

Of all the boards in the Computer System, the memory board requires the greatest soldering care. After making each solder connection check to make sure you haven't created any solder "bridges".

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use two separate soldering irons as mentioned in the introduction; one for small connections, the other for large ones. Do not use acid core solder or any type of paste flux. We will not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on

the board.

( ) Install all of the capacitors on the board. Be sure to orient the electrolytic capacitor correctly. Use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. The polarity is indicated on the component layout drawing. Solder.

( ) Install integrated circuit IC41 on the circuit board. This component must be oriented so its metal face is facing the circuit board with the small metal heatsink sandwiched between the two. The heatsink and IC are secured to the circuit board with a #4 - 40 x 1/4" screw, lockwasher and nut. The three leads of the integrated circuit must be bent down into each of their respective holes and the heatsink must be oriented as shown in the component layout drawing. Solder.

NOTE: MOS integrated circuits are susceptable to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (seperately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC25 thru IC40 following the precautions given in the preceding section. As each is installed, make sure it is down firmly against the board and solder only two of the leads to hole the pack in place while the other IC's are being installed. Be very careful to install each in its correct position. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for each of the IC's.

( ) Now that all of the components have been installed on the board, double check to make sure that all have been installed correctly in their proper location. Solder the remaining IC pins.

( ) Working from the "TOP" side of the board fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes that make electrical connection from the "TOP" of the board to the "BOTTOM" of the board. Do not fill in the holes marked A and 0 - 7.

( ) Check very carefully to make sure that all connections have been soldered.

It is very easy to miss some connections when soldering which can really cause some hard to find problems later during check out. Also look for solder "bridges" or "cold" solder joints which are another common problem.

This completes the installation for the MP-MX Memory Expansion Kit. Since the circuit board now contains MOS devices it is susceptable to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

Checkout Procedure

Before checking out any of the memory boards, you must have a properly working computer system. The memory board(s) should not even be plugged onto the MP-B mother board until the system has been completely checked out.

NOTE: Before checking out the memory board it must be jumper programmed for the proper address selection. The jumper pads are on the right side of the board when viewing it from the "TOP" side with the connector edge down. Only one jumper may be installed and it is run from point A to one of the pads numbered 0 thru 7. Only pads 0 and 7 are marked but the numbers progress sequentially between the two. The first memory board installed on the system's mother board should be programmed #0 with subsequent boards following sequentially. Each 2,048 word memory board should be expanded to the full 4,096 word capacity with the MP-MX kit before the next sequential memory board is added. There must never be two memory boards on the same system having the same address assignment jumper. Although there are eight possible address assignments, it would take two systems of memory boards to use all eight since each system should have no more than four memory boards on it.

( ) Attach and solder the selected address jumper using a piece of insulated wire.

( ) Remove the system's AC power if applied.

( ) Check over the MP-M Memory board to see that all connections have been soldered and that there are no solder or foil conductor "bridges" or "breaks".

( ) Looking at the MP-B Mother board from the front of the chassis and with the MP-M Memory board oriented so you are viewing the "TOP" side, set the board down lightly on one of the connector rows of the Mother board. Electrically the board may be plugged onto any one of the seven main board positions. Check to see that the index pin on both the MP-M board and MP-B board align. They should align, if not there is a mistake.

( ) Assuming the index pin aligns, press the MP-M board down perpendicularly onto the mother board. Be sure the MP-M board seats firmly against the mother board.

( ) Again apply AC power to the unit. Using one of the GND pins on the mother board as a reference, measure the voltage on the right most lead of voltage regulator IC41 on the MP-M board. The reading should be +5 VDC ±5%. If not, something is wrong.

( ) Enter and run the ROBIT and MEMCON memory diagnostic programs listed in the software section of the System Documentation Notebook. Use the tables listed at the end of this instruction set to determine the proper starting and ending memory addresses to be entered for the programs. For example, if the memory board to be tested is board address selected #0 and the board had only 2.048 words of the 4,096 word memory capacity, then the lowest address on the board is 0000 and the highest address is 07FF. If the board has the full 4,096 words of memory then the highest address would be 0FFF. If either of the programs indicate errors, you can re-run the diagnostics on 1,024 word increments of memory to help pinpoint the source of the problem. There is always the chance of a bad IC but experience has shown that most problems will be the result of a solder or foil conductor "bridge" or "break". So get out the magnifying glass and check the board over very carefully if you have problems.

How It Works

Each of the memory chips on the board is a 1 x 1024 bit static random access memory IC storing one of the eight bits of each word within one of the four, 1,024 word memory quadrants. The acutal bit and quadrant assignment of each memory IC is given in the table at the end of this instruction set. The then address lines A_0 thru A_9, as well as the R/W of all of the memory IC's on each board are paralleled. Because of the large capacitances generated by this paralleling, integrated circuits IC18 and IC19 are used as non-inverting buffers to drive the forementioned lines. The actual address selection for each of the four, eight bit 1,024 word quadrants is done using 1 of 8 decoders IC22 and IC23 feeding the paralleled chip enable (CE) lines on each of the eight intergrated circuits within each quadrant.

Since the eight bit data buss for the computer system is bi-directional, bi-directional transceiver/buffers IC20 and IC21 buffer the incoming and outgoing data to and from the memory board to the data buss. Integrated circuit NOR gate, IC24 B, C and D enable the outgoing sections of the bi-directional transceivers IC20 and IC21 at the appropiate times while the incoming sections of the bi-directional transceivers are enabled at all times since the memory IC's have separate input/output lines. +5 volt power for the lower 2,048 words of memory (IC1 - IC16) plus the decoders and buffers (IC18 - IC24) is supplied by voltage regulator IC17. +5 volt power for the upper 2,048 words of memory (IC25 - IC40 where applicable) is supplied by voltage regulator IC41. The various capacitors are used on the board to reduce power supply buss noise.

Parts List - MP-MX Memory Expansion Kit

Capacitors

C6	100 mfd @16 volt electrolytic capacitor
C7 - C9	0.1 mfd disc capacitor

Semiconductors

IC-25 - IC40	2102-1 or 2 Static random access memory (MOS)
IC41	7805 5V 1A regulator

Memory Address Assignment Table Hex

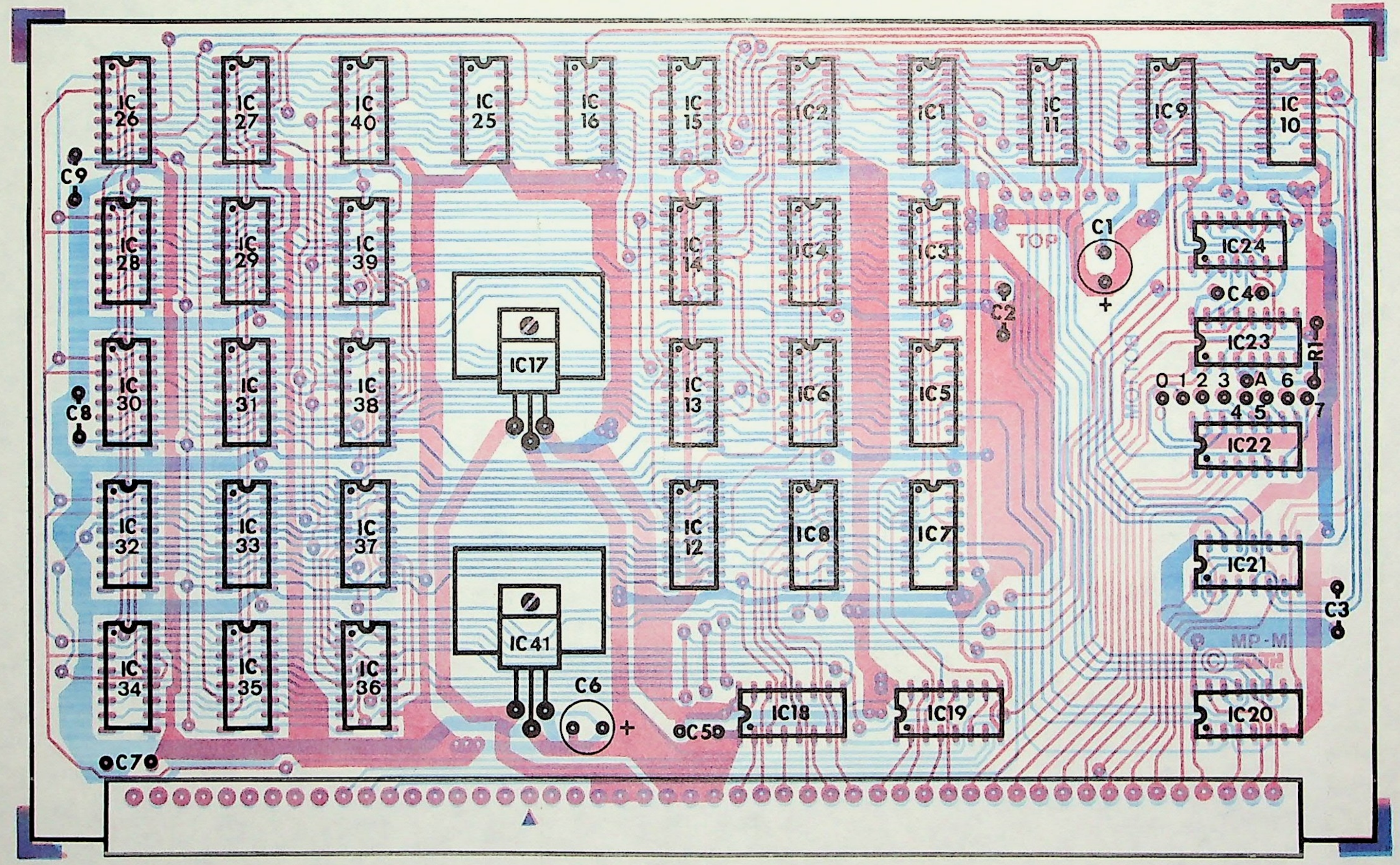
Board #	**Memory Quadrant (K of memory)**	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

08 hex = **0000 1000 binary**
10 hex = **0001 0000 binary**
20 hex = **0010 0000 binary**
40 hex = **0100 0000 binary**
80 hex = **1000 0000 binary**



IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
TOP
C1
+
IC24
C2
C4
IC17
IC23
R1
0 1 2 3 A 6
4 5 7
C8
IC 30
IC 31
IC 38
IC 13
IC6
IC5
IC22
IC 32
IC 33
IC 37
IC 12
IC8
IC7
IC21
C3
IC41
MP-M
©
IC 34
IC 35
IC 36
C6
+
C5
IC18
IC19
IC20
C7

Memory Address Assignment Table (Hex)

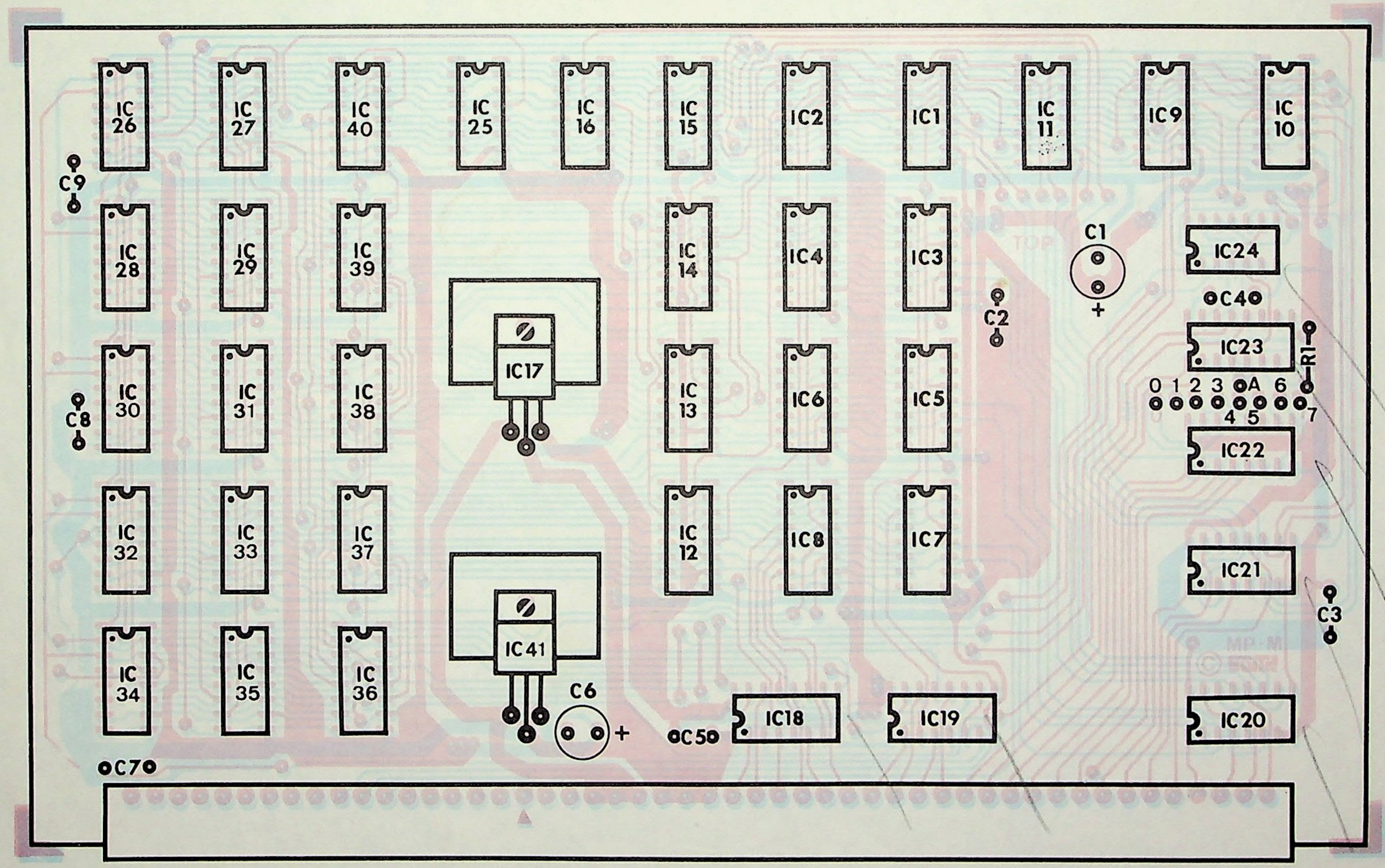
Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K)	IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1
Quadrant 2 (2K)	IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2
Quadrant 3 (3K)	IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26
Quadrant 4 (4K)	IC25	IC39	IC37	IC35	IC33	IC31	IC29	IC27

00 hex = 0000 0000 binary
01 hex = 0000 0001 binary
02 hex = 0000 0010 binary
04 hex = 0000 0100 binary

08 hex = 0000 1000 binary
10 hex = 0001 0000 binary
20 hex = 0010 0000 binary
40 hex = 0100 0000 binary
80 hex = 1000 0000 binary


IC 26
IC 27
IC 40
IC 25
IC 16
IC 15
IC2
IC1
IC 11
IC9
IC 10
C9
IC 28
IC 29
IC 39
IC 14
IC4
IC3
TOP
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IC24
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IC23
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IC 30
IC 31
IC 38
IC 13
IC6
IC5
0 1 2 3 A 6
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IC22
IC 32
IC 33
IC 37
IC 12
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IC7
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IC 34
IC 35
IC 36
IC41
C6
+
C5
IC18
IC19
IC20
C7